AFRL-IF-WP-TR-1998-1535

DATA INTEGRATION AND COLLECTION ENVIRONMENT SYSTEM

David Priester

TRW
293 Hwy 247 South
Warner Robins GA 31088

JUNE 1997

FINAL REPORT FOR PERIOD 10 DECEMBER 1990 – 27 JUNE 1997

Approved for public release; distribution unlimited

INFORMATION DIRECTORATE
AIR FORCE RESEARCH LABORATORY
AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OH 45433-7334

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government related procurement, the United States Government incurs no responsibility nor any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell patented invention that may in any way be related thereto.

This technical report has been reviewed and is approved for publication.

Tod J Reinhart

TOD J. REINHART, Project Engineer
Embedded Information Systems Engineering Branch
AFRL/IFTA

James S. Williamson

JAMES S. WILLIAMSON, Chief
Embedded Information System Engineering Branch
AFRL/IFTA

James S. Williamson
FOR
EUGENE C. BLACKBURN

EUGENE C. BLACKBURN, Chief
Information Technology Division
AFRL/IFT

IF YOUR ADDRESS HAS CHANGED, IF YOU WISH TO BE REMOVED FROM OUR MAILING LIST, OR IF THE ADDRESSEE IS NO LONGER EMPLOYED BY YOUR ORGANIZATION, PLEASE NOTIFY AFRL/IFTA, BLDG 620, 2241 AVIONICS CIRCLE, WRIGHT-PATTERSON AFB, OH 45433-7334 TO HELP US MAINTAIN A CURRENT MAILING LIST.

COPIES OF THIS REPORT SHOULD NOT BE RETURNED UNLESS RETURN IS REQUIRED BY SECURITY CONSIDERATIONS, CONTRACTUAL OBLIGATIONS, OR NOTICE ON A SPECIFIC DOCUMENT.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	JUNE 1997	FINAL 10 DEC 90 - 27 JUN 97

4. TITLE AND SUBTITLE

DATA INTEGRATION AND COLLECTION ENVIRONMENT SYSTEM

5. FUNDING NUMBERS

C: F04606-89-D-0040/RZ04
PE: 78012F
PR: 3090
TA: 02
WU: 28

6. AUTHOR(S)

David Priester

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

TRW
293 Hwy 247 South
Warner Robins GA 31088

8. PERFORMING ORGANIZATION REPORT NUMBER

57629-A003RU1021-A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Information Directorate
Air Force Research Laboratory
Air Force Materiel Command
Wright-Patterson Air Force Base, OH 45433-7334
POC: Tod J. Reinhart, AFRL/IFTA, 937-255-6548 x 3582

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

AFRL-IF-WP-TR-1998-1535

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The major goal of the Data Integration and Collection Environment (DICE) program was to develop a flightworthy prototype of an on-board instrumentation system capable of collecting pertinent data from an embedded information system. The target platform was the F-15 APG-63 radar.

14. SUBJECT TERMS

Information Technology, Instrumentation System, Information Support, Data Collection System

15. NUMBER OF PAGES

28

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

Table of Contents

1. INTRODUCTION 1

2. REFERENCES 3

3. REQUIREMENTS 4

4. CURRENT FLIGHT TEST CAPABILITIES 6

4.1 PSP Instrumentation Interface Unit 6

4.2 Instrumentation Recorder 7

4.3 Instrumentation Data Reduction Analysis System 7

4.4 Test Aircraft 7

5. CURRENT RECORDER TECHNOLOGY 9

5.1 Selected System 10

6. PHYSICAL CONSTRAINTS 11

7. REQUIRED INTERFACES 12

7.1 System Costs 12

8. DICE SOFTWARE REQUIREMENTS 13

9. DICE SYSTEM 16

10. FUTURE RECOMMENDATIONS 21

10.1 Provide Procurement Package 21

10.2 Single Card IIU for PSP 21

10.3 Repackage Hardware CCA Design for Greater Generic Design 22

10.4 Target Another Platform 22

10.5 Limited Production for Evaluation Units 22

10.6 PC-Based Data Reduction System 22

10.7 Review Other Data Recording Options 22

10.8 Logistics Supportability Analysis 22

11. CONCLUSION 23

12. ACRONYMS 24

List of Figures

Figure 1-1. Example of Flight Instrumentation System 2

Figure 4-1. Instrumentation Interface Unit (COMPTEK) 7

Figure 8-1. Start Up Flow Chart 14

Figure 8-2. Record Process Flow Chart 15

Figure 9-1. DICE System Block Diagram 18

Figure 9-2. Block Diagram of DICE Electronics Unit 19

Figure 9-3. Interconnect Diagram 20

List of Tables

Table 5-1. Recorder Technology Terms Definitions 9

Table 5-2. Recording Technology Advantages 10

Table 7-1. DICE System Cost Summary 12

Table 8-1. Default Collection Configuration Header 13

Table 9-1. System Specifications Summary 17

1. INTRODUCTION

Data Integration and Collection Environment (DICE) is a project that is a follow-on to the Radar Readiness Technologies Study done by TRW in 1988. That study found that radar data collected from tactical aircraft encounters would give significant insight into finding solutions to electronic countermeasures (ECM)/electronic counter-countermeasures (ECCM) problems encountered in the field. The best and latest ECM technique will be seen for the first time when there is the least time to counter it.

DICE is an attempt to put a low-cost recorder on all tactical F-15 aircraft outfitted with the APG-63 radar. The system would supply the ECCM engineers with real data from inside the fire control system. The minimum capability for the initial design is to duplicate the developmental flight test instrumentation system built by Hughes Aircraft Corporation (HAC) (see Figure 1-1) in a small package that can easily be mounted in the fleet aircraft. The size of the system is one air transport racking (ATR) short with an additional tape recording subsystem of 15" X 7" X 6". One ATR is 10.09" wide x 7.64" high x 12.76" long. The system will use the current data reduction and analysis programs and equipment that were developed by HAC. This will provide the users with a familiar system.

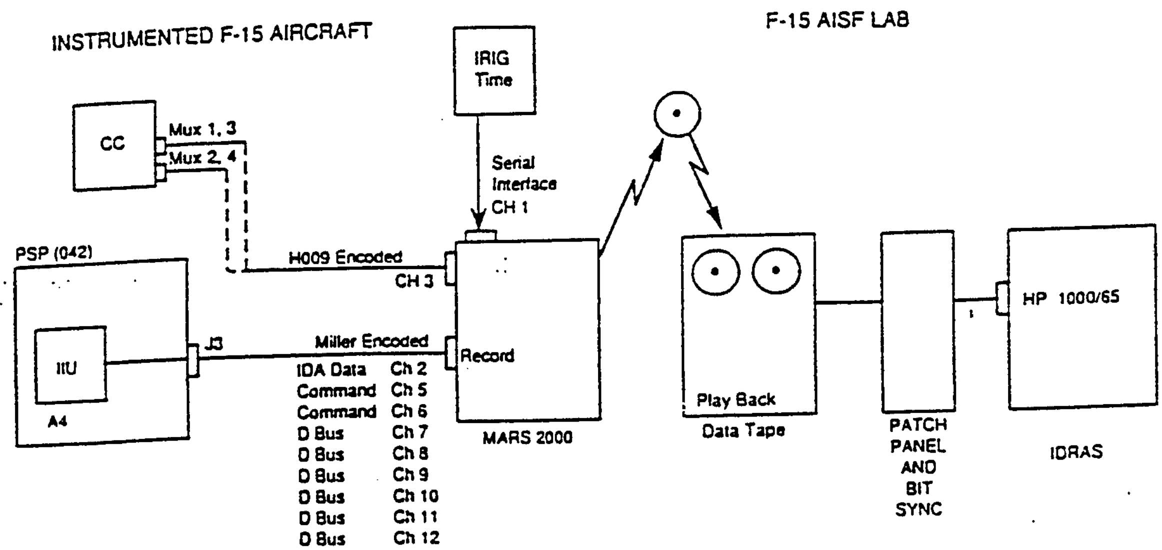

Figure 1-1. Example of Flight Instrumentation System

2. REFERENCES

TRW-WRAL	Radar Readiness Technology, Contract No. F33615-87-C-1538
H-009, 12 March 1969	MCAIR Report
3173914-100	Programmable signal Processor Reference Manual, Hughes Aircraft Corporation
Doc No. HAC, 7 May 1980	F-15 Instrumentation Interface Unit (IIU) Specification, Hughes Aircraft Corporation
DOD-STD-1788 15 May 1985	Avionics Interface Design Standard
MIL-STD-1788 19 July 1983	Avionics Interface Design Standard
MIL-STD-810D, 19 July 1983	Environmental Test Methods and Guidelines
MIL-STD-1553B, 21 September 1978	Aircraft Internal Time Division Command/Response Multiplex Data Bus
MIL-E-5400T, 9 May 1986	Electronic Equipment, Aerospace General Specification
MIL-STD-1472D, 14 March 1989	Human Engineering Design Criteria For Military Systems Equipment And Facilities
January 1995	DICE Instrumentation System Design Report
30 June 1989 SD171500009-01	Airborne Instrumentation Interface Unit System Manual, COMPTEK Research Inc.
	Programmer's Reference Manual

3. REQUIREMENTS

To support the development and maintenance of radar systems in general, and ECCM in particular, the engineer must understand the behavior of the system while it is being jammed. Sufficient data must be recorded and provided to the engineer. What is required is a system compact enough to go on a tactical the recording of needed data. Currently the following data is accessible for recording on the aircraft without major modifications and includes the data most useful for analysis as identified by analysts for the APG-63 Radar.

a) D-Bus Data (Doppler Filter Outputs) - This data is taken from the programmable signal processor (PSP) backplane and controlled by the programmers that develop the PSP software. The essential data extracted from the D-Bus is the output of the velocity filters sorted by range bin. The data rate varies with radar mode. The maximum occurs in the medium pulse repetition frequency (MPRF) initial track mode which (at a normal process sync rate of 8.6ms) is:

   (1024 words/8.6ms) (4 bytes/word) = 476,279 bytes/sec

   If the process sync rate is 5.12ms, the data rate becomes

   (1024 words/5.12ms) (4 bytes/word) = 800,000 bytes/sec

b) PMUX (Command Data) - The PMUX data words are received from the radar data processor (RDP). The words contain commands and PSP instructions to be used in signal processing. The data bandwidth on this bus also varies with mode. The maximum is in the MPRF search mode which has a message of 16 words every process sync period.

   (16 words/8.6ms) (4 bytes/word) = 7442 bytes/sec

c) IDA Data (Target Reporting) - The IDA data contains 15 words per process sync and contains target Doppler, range, and signal amplitude. This bus rate is independent of mode. The data rate is:

   (15words/8.6ms) (4 bytes/word) = 6977 bytes/sec

If the internal process synch rate of the PSP for certain radar modes is faster, (some sources have indicated a 5.12 millisecond rate), the data rate will be correspondingly higher for these data sources.

d) HOO9 CC MUX Data (Target Information to Central Computer and Mission Time) - The CC MUX data consists of up to 256 words at a 50 millisecond rate for each bus pair (1/3 and 2/4). This gives a maximum data rate of:

   (256 words/50ms) (4 bytes/word) = 20,480 bytes/sec

   For the monitoring of both busses, this gives a total of 40,960 bytes/sec.

e) Weapons/PACS Bus - The weapons bus is a MIL-STD-1553-B bus that connects the programmable armament control set (PACS) to the weapons stations. The data rate for this bus pair is estimated at:

   (70 words/50ms) (4 bytes/word) = 5,600 bytes/sec

The above data rates combined with overhead data handling and a time tagging function gives an estimate input data rate of 538,268 bytes/second. If the faster PSP process sync rate applies, this number becomes 872,421 bytes/second.

In addition to collecting the data discussed in the preceding paragraphs, the system must time tag the data to a usable time standard to allow processing of the data post mission. The fact that the system can access the aircraft mission time in the central computer (CC) from the CC MUX bus allows use of that time to set up an on-board counter as a time stamper, which can be checked for synchronization with CC time periodically. The resolution of this time is 1 millisecond which is fully adequate.

4. CURRENT FLIGHT TEST CAPABILITIES

4.1 PSP Instrumentation Interface Unit

The instrumentation interface unit (IIU) module buffers, formats, and encodes digital data from three different busses in the PSP. The output of the IIU is then recorded on a multi-track recorder. There are three different versions of the IIU, but programmer control of the different units is identical.

The first version of the IIU was built by HAC and is inserted into shop replaceable unit (SRU) slot A4 of the PSP. The interconnect is then made from J3 of the PSP to the recorder. This version was designed with 1970s technology and will be nonsupportable in the 1990s.

The second version is identical to the first version except the P-MUX or command data is in a different format and is called M-BUS data. This version is a modified first version and will also be nonsupportable in the 1990s.

The third version is built by COMPTEK Research, Inc. (see Figure 4-1) and is quite different from the first two. It consists of two SRUs, a cable, and a line replaceable unit (LRU). In addition, this version extracts raw in-phase and quadrature digitized video (I/Q data) from both analog processor channels. So far, this version is not used at Robins AFB. Part of this version is used in the Advanced Radar Test Bed operated by the 4950th TW at Edwards AFB and the Radar Test Facility at Tyndall AFB. Both of these installations use the extractor cards that fit into A4 and A19 slots of the PSP. The signals are present at J6 and J10.

PMUX and IDA-BUS data are monitored continuously by the IIU with no programmer interaction required. D-BUS data is recorded either by programming the IIU as a destination in the instruction or by setting up the IIU (via program output [POUT control]) to record all D-BUS data being sent to the Bulk Memory 2 module.

Programmer control of the IIU is accomplished with the POUT register, as described in the Programmers Reference Manual. The following commands are available and are covered in more detail in the HAC IIU Specification.

0 - Set block label counter to zero
1 - Set D-BUS record length
2 - Set tape speed (output rate of IIU)
3 - Write super page, Xmit to test access
4 - Open D-BUS window, destination = Bulk memory 2 data
5 - Spare
6 - Ping pong D-BUS buffers

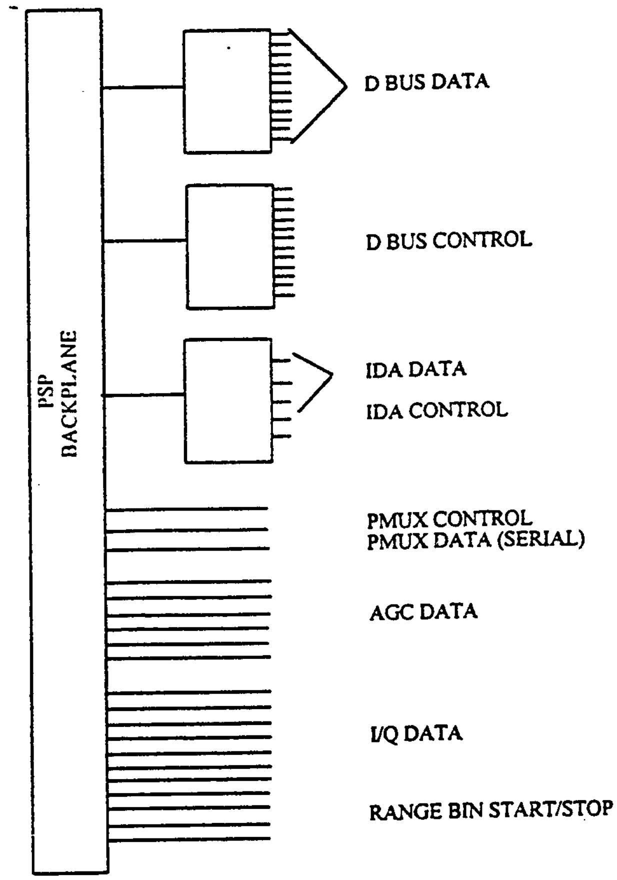

Figure 4-1. Instrumentation Interface Unit (COMPTEK)

4.2 Instrumentation Recorder

A Datatape MARS 2000 recorder in aircraft 068 and a MARS 1400 recorder in aircraft 116 are used to store the data in two test aircraft. These recorders are 14 track direct record connected with an IRIG time track. The data is recorded at 15 IPS. For a 9,000-foot tape, that is two hours of record time. The tapes are returned to the F-15 Avionics Integration Support Facility (AISF) at Robins AFB for playback and analysis.

4.3 Instrumentation Data Reduction Analysis System

The Instrumentation Data Reduction Analysis System (IDRAS) was built by HAC and installed at RAFB for flight test data analysis. It has been upgraded over time and is currently hosted on an HP9000 computer system. The IDRAS can process data from either flight tests or data recorded in the F15 AISF. The operational data recording system should produce data that can be processed on the IDRAS system.

4.4 Test Aircraft

The original concept for the DICE program had been to conduct a proof of concept on one of the instrumented test aircraft then stationed at RAFB. These aircraft have been transferred to Eglin AFB

since the beginning of the DICE program. Tail number 068 supports the pre-Multi-Stage Improvement Program (MSIP), 24K and 96K radar configurations. Tail number 116 supports the MSIP configuration. The instrumentation systems on these aircraft have been described earlier in this document.

The true proof of the system is the demonstration on an operational aircraft. The aircraft (83-0037) chosen for the DICE flight test demonstration is one of several Operational Test and Evaluation aircraft stationed at Nellis AFB. The aircraft is a standard operationally configured aircraft unlike the instrumented aircraft described above.

5. CURRENT RECORDER TECHNOLOGY

A better term for "recorder" is "data storage device" because solid state memory and magnetic memory are becoming sufficiently dense to replace tape and disk in certain applications. In a discussion of the relative merits of the data storage technologies for this application, the terms access time, data rate, and capacity must be defined. Refer to Table 5-1 and 5-2.

Table 5-1. Recorder Technology Terms Definitions

TERM	SMALL	MEDIUM	LARGE
Access Time	Nano- Micro-Sec	Milli-Seconds	Minutes
Data Rate	HZ	KHZ	MHZ
Capacity	Megabytes (MB)	Hundreds MB	Gigabytes (GB)
Cost	< $10 / MB	$10 -$100 / MB	> $100 / MB

Solid State Memory - Used where extremely fast access time, small size, and small capacity are driving factors. Cost not a major consideration.

Magnetic Disk - Used in applications where random access times are in milliseconds but data rates are high and capabilities required are medium. Disk storage is medium cost per MB.

Optical Disk - Used where medium access time and medium data rates are acceptable but medium to large capacities are needed. Optical disk is medium cost per MB.

Magnetic Tape - Used where access time is not an issue but data rates and capabilities must be high. Magnetic tape is available from low to high cost depending on the data rate required.

The requirements for DICE can be summarized as follows:

Access Time - not critical for DICE
Data Rate - 872 KB/sec
Capacity - greater than 1 hour or 1.8 GB (the current test instrumentation system runs for two hours)

Table 5-2. Recording Technology Advantages/Disadvantages.

Capability vs Cost

Solid State Memory Per Unit		
SRAM	$190K 400MB at 500KB/s	$240/MB
Optical Disk Honeywell	$75K 520 MB at 4.5 MB/s	$144/MB
Maximum Duette Disk (ruggedized)	$15k 1 GB at 1 MB/s	$15/MB
Magnetic Disk Miltope 5.25 Hard Disc	$8.3K 760 MB at 500 KB/s	$10.9/MB
Magnetic Tape Ampex DCRSi Tape	$135K 40 GB at 13 MB/s	$110.4/MB
VHS Tape	$48K 10.4 GB at 500 KB/s	$4.6/MB
8 mm Tape (ruggedized)	$13K 5 GB at 500 KB/s	$2.6/MB

5.1 Selected System

The system selected for DICE prototype is the 8 mm cartridge tape system manufactured by Exabyte and ruggedized by Aydin Vector. It represented the best solution trading off weight, size and, cost against its performance. Even though its standard throughput was below the requirement for DICE, the fact that the data rate could be reduced by recording every other data frame (implementation of a Divide-by-N" function in the DICE software) made it acceptable. This reduction in data recorded is acceptable as APG-63 analysts consider data from every fourth frame as usable. Also, the chosen tape system includes a data compression algorithm which increases its effective data throughput rate and storage capacity beyond the standard 500 Kbytes/sec and 5 GB, respectively. Although there is a potential for doubling those numbers, early tests with the DICE system have shown an improvement of approximately 60%.

6. PHYSICAL CONSTRAINTS

The major physical concerns in the aircraft environment are size, weight, temperature, vibration, and shock. Most electronic equipment made for aircraft installation is packaged in ATR boxes. These are standard sizes as specified by DOD-STD-1788. When looking for a candidate slot on a tactical aircraft, the ideal space is one ATR. This requirement is desirable and easy to satisfy.

Weight should be kept to a single-person carry limit of 37 lbs. which is required for ground maintenance per MIL-STD-1472C.

Temperature is a major consideration for an application on an aircraft that may fly to an altitude of 50,000 ft. or land in a tropical region. Tapes have a limited operating temperature range between 40 degrees F and 105 degrees F. Within that range, the humidity must be between 5 percent and 95 percent. Since the system operates only when the aircraft is flying, cold stress is the major concern. Putting the unit in an insulated container controls the temperature.

Vibration can be controlled by means of shock mounts and ruggedized internal components.

7. REQUIRED INTERFACES

To accomplish a tactical system installation, an IIU must be installed in the PSP of the host aircraft to extract radar data. The COMPTEK card set presented the best solution based on its parallel data formats. The DICE system includes an interface circuit card that receives the data from the IIU. An additional interface circuit card is required to interface with the CC MUX bus. Coupling to the CC MUX bus is accomplished via a transformer tap at a cable splice bundle near the CC. The final interface to the aircraft is the tie in to the PACS bus which is accomplished with another transformer tap in at the bus coupler for weapon station 3.

7.1 System Costs

The estimated costs associated with a production version of DICE are summarized in Table 7-1.

Table 7-1. DICE System Cost Summary

Item	Prototype	Estimated Production
Enclosure	$25,750	$8,990
CPU	$24,310	$13,355
H009	$9,300	$4,800
PSP	$9,800	$6,000
SCSI	$12,345	$6,870
1553	$12,190	$7,490
PSP IIU	$0	$10,000
Tape	$14,820	$11,450
Cabling	$7,200	$4,000
Total	$115,715	$72,955

8. DICE SOFTWARE REQUIREMENTS

The DICE software consists of a single computer software configuration item (CSCI) written in Ada. It forms the functions of processing (for filtering) and recording data sourced by the CC, the APG-63 Programmable Signal Processor, and the PACS weapons system. The software is written to handle VME interrupts from the H009, PSP, and 1553 interfaces. The real-time data is captured from the interface cards and stored to an 8mm data cartridge for post data analysis. The DICE System provides the capability to configure the DICE system for specific missions and specific data sets, the software provides the means to configure the hardware interfaces to a pre-determined configuration. The DICE system is capable of configuring the hardware interfaces according to this preflight configuration. If a configuration is not present, a default configuration will be used.

The software also provides a means of selectively recording real-time data based upon a predefined filtering criteria. This pre-flight filtering criteria is also a part of the configuration parameters defined off-line.

The DICE system software provides built-in test (BIT) results of al! custom cards in order to verify the operational capability of the system. BIT results of commercial-off-the shelf COTS cards is provided via the commercially available on-board firmware. Figure 8-1 shows a functional flow chart of the DICE software for the start up/initialization states and Figure 8-2 shows the operational/record process flow.

The software for providing the configuration information for DICE consists of an editor that presents the data in a table format and the user merely fills in the changes. Default information is shown (Table 8-1.) shows the default configuration table. This data is then loaded to a tape as a header. Upon power up, the DICE system will look for a header and read it if it is there. Otherwise, it will read its default configuration from firmware.

Table 8-1. Default Collection Configuration Header

DPIP	not installed
Smart Recording	off
Trigger Mode	N/A
D BUS Switch	enabled
IDA Switch	enabled
PMUX Switch	enabled
Divide-By-N Counter	2
Divide-By-N Automatic "bump"	disabled
H009 Switch	enabled
H009 Select words	$103A
	$2031
	$304F
	$7035
	$9037
	$B02A
	$F02A
	$4031
	$503C
	$603B
	$8022
	$A03F
	$C008

Table 8-1. Default Collection Configuration Header (Continued)

	$E029
Time-Tag Initialization	CC Time-of-day
1553 Switch	enabled
Time-Tag Initialization	CC Time-of-day
1553 Switch	enabled

Note: DICE Pilot Interface Panel was not implemented on the prototype. Divide By-N-Counter represents how many process synch frames are collected (e.g 2 means every second frame is collected)

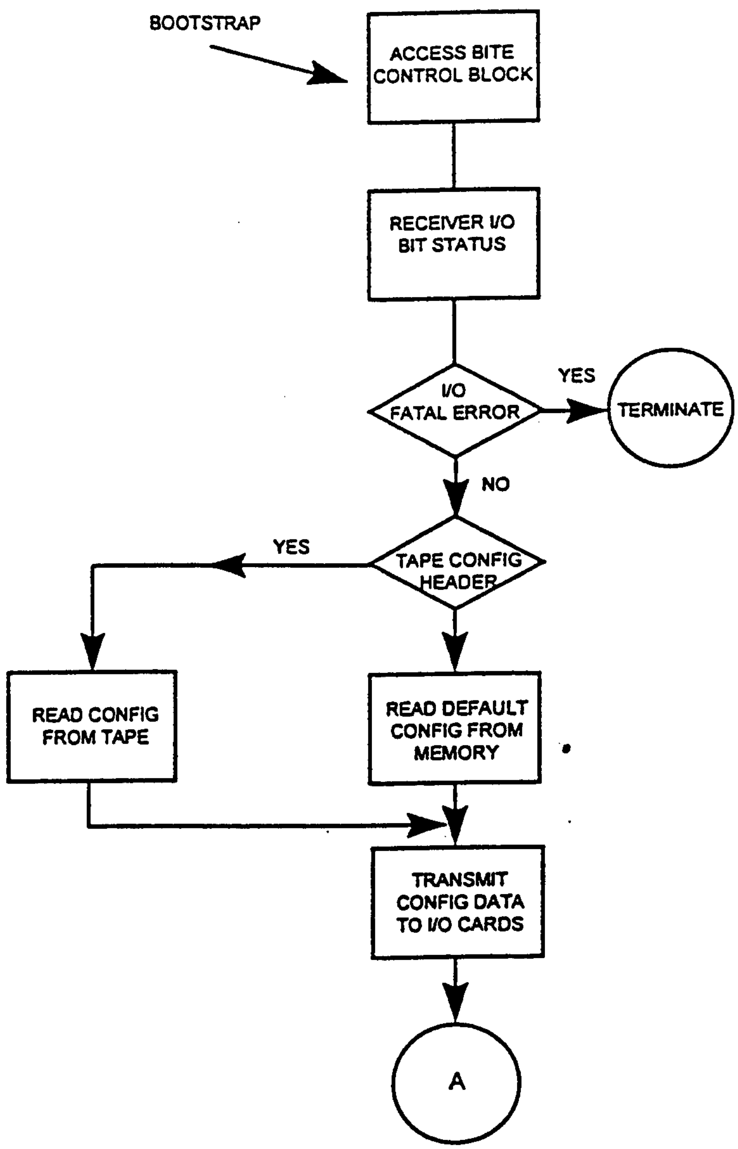

Figure 8-1. Start Up Flow Chart

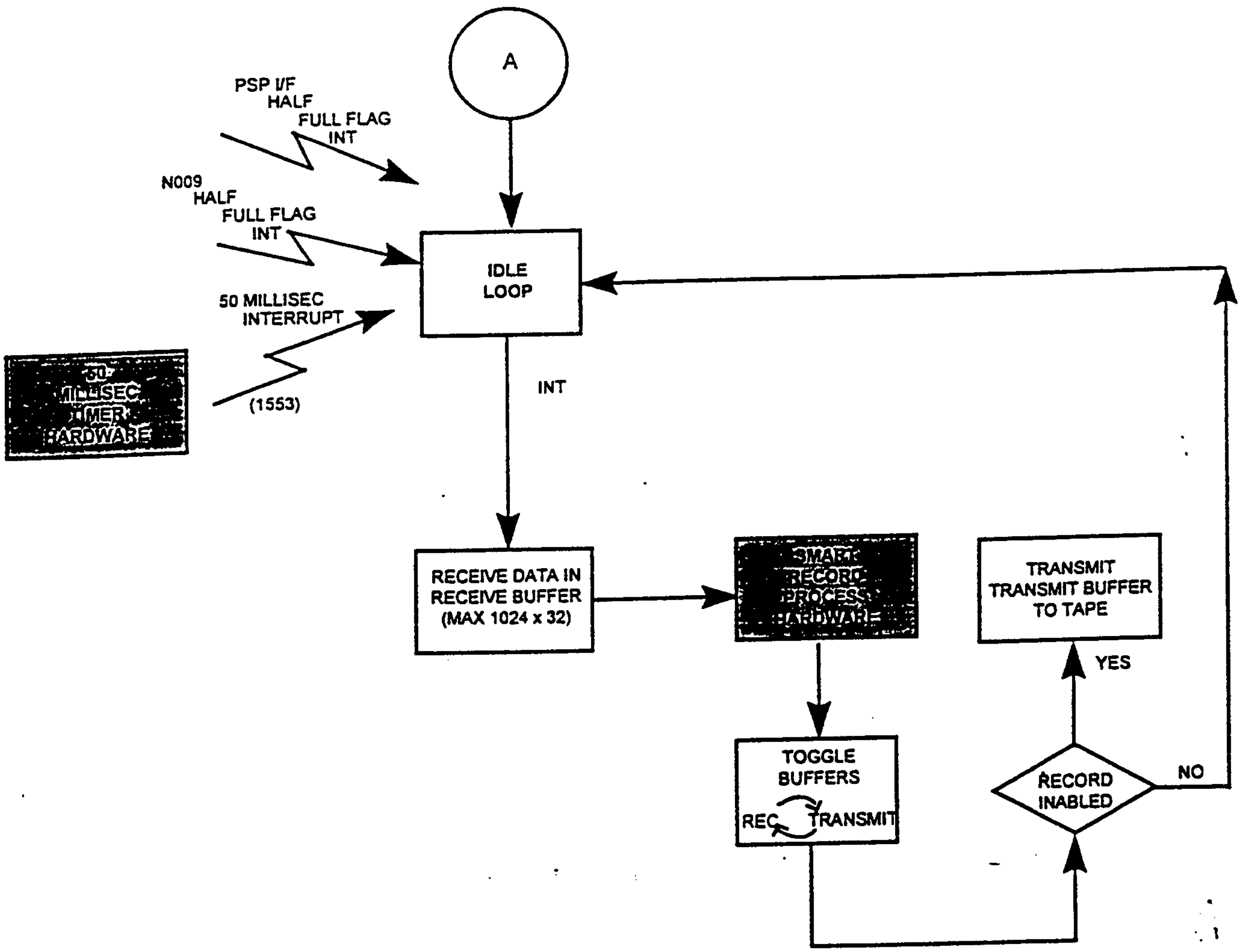

Figure 8-2. Record Process Flow Chart

9. DICE SYSTEM

Previous sections have presented the requirements as resulted from the analysis performed at the beginning of this project. This section will outline the DICE system as implemented. More technical details of the DICE system are provided in the Instrumentation System Design Report. Table 9-1 is a summary of the system specifications. Figure 9-1 is a block diagram depicting the two components and the systems to which they interface.

The DICE system consists of two LRU's and associated interconnecting cabling. The first LRU is the Electronics Unit and consists of a standard full ATR short chassis. The second LRU, the Tape Unit, is a tape recorder subsystem in a ruggedized package.

The Electronics Unit contains the central processing unit (CPU) card and interface circuit card assemblies for the PSP, H009, 1553, and Small Computer System Interface (SCSI). Figure 9-2 is a block diagram showing the components of the Electronics Unit. The Tape Unit contains the 8mm cartridge tape system in a shock and environmentally shielded package.

As discussed previously, an IIU manufactured by COMPTEK must be installed in the PSP. Cables from connectors J6 and J10 on the front panel of the PSP run to the DICE Electronics Unit. Another cable runs from a HOO9 cable splice bundle behind the CC to the DICE Electronics Unit. The 1553 is cabled from the weapon station bus coupler located in the space with the DICE system. Power for the tape unit is taken from existing wiring for the HUD Video Tape System which is being replaced and the Signal Data Recorder System which is only installed on aircraft with tail numbers evenly divisible by 5. Figure 9-3 is an interconnect diagram for the system.

The DICE system can operate in either a free running mode or in a selective data recording mode (Smart Record Mode) where the decision to record is based on the mode of the radar. The configuration can be loaded as a header onto the tape and read in as part of the power on initialization of the system. Tapes collected at the end of a mission can be returned to the F15 AISF for analysis of the data they contain. The collected data may be sent via AUTODIN to speed the transfer of the data to Robins AFB.

Table 9-1. System Specifications Summary

PROTOTYPE SYSTEM SPECIFICATIONS
Weight: - 48 lbs (34 lbs. + 14 lbs.)
Configuration: Two units **Size: 1 ATR short** **(17.1" x 10.1" x 7.75")** **8 mm Cartridge Tape Subsystem** **(15" x 7" x 6")**
Operating Altitude: Up to 50,000 feet
Power: 28 vDC and 115 vAC three-phase **(47 to 400 Hz)**
Temperature: -55 degrees C +71 degrees C

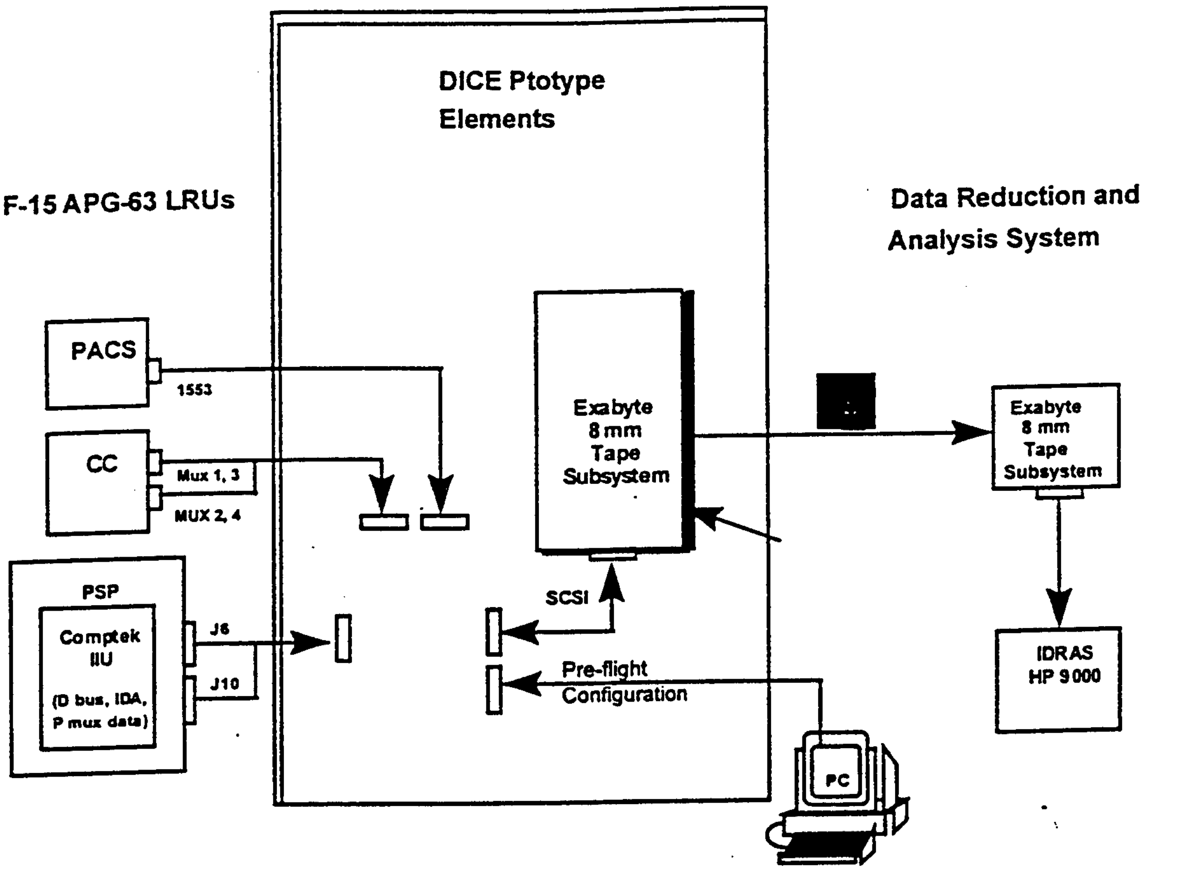

Figure 9-1. DICE System Block Diagram

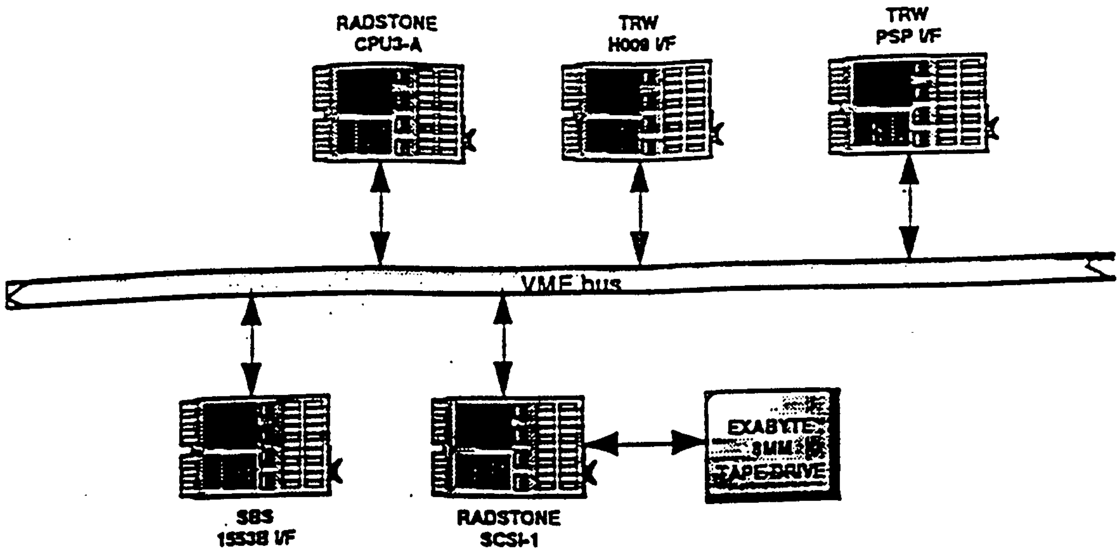

Figure 9-2. Block Diagram of DICE Electronics Unit

10. FUTURE RECOMMENDATIONS

A production packaging of the system needs to be determined. There is a possibility of reducing the ATR size enclosure to a 1/2 ATR size. This could be determined as part of producing an overall procurement package and/or producing additional evaluation units. Improvements in the IIU card and resegmenting of the DICE interface cards to define a more generic core to the system are worth considering. Another possibility is to take the next step of tailoring the system for installation on another aircraft. Serious consideration should be given to developing personal computer based support and data analysis tools for the DICE system. This would allow some preliminary review of data at the base where the aircraft is stationed. Other data recording system options can be considered based on technology improvements in this area. These and other possibilities are discussed in the following sections.

10.1 Provide Procurement Package

The current contract does not include providing the documentation required for the Government to go out for a production contract. A procurement package would contain (but not necessarily be limited to) the following items:

a) User Manual

b) TO for System

c) Drawing Package

d) Fabrication Specification

e) Software Product Specification

f) Printed Circuit Board Package (Gerber Files, NC Drill Chart, Net List)

10.2 Single Card IIU for PSP

This task could take several paths.

a) TRW has requested information from COMPTEK for the cost of the IIU card repackaged as a single card unit. If the cost is acceptable, the Government could purchase the cards from them in the new configuration.

b) The Government has sufficient documentation on the COMPTEK IIU card and TRW has sufficient knowledge to design a new IIU card. This would have the added advantage of allowing unique target system interface characteristics to be handled on this interface card and removing that unique interface circuitry from the DICE PSP interface circuit card. Thus the DICE system would become more generic and the unique platform interface characteristics would be contained on the IIU which would have to be unique for each target platform anyway. This would go hand-in-hand with section 10.3.; the simplification of the repackaging to merely eliminating the unique interface circuitry.

10.3 Repackage Hardware CCA Design for Greater Generic Design

The DICE PSP interface circuit card design could be repackaged with the generic DICE circuitry on a mother board and the platform unique circuitry on a daughter card. This would allow changing the daughter card only for retargeting future platforms. If 10.2 was accomplished, this repackaging would be simplified to just the elimination of the unique interface circuitry from the DICE interface circuit card assembly (CCA).

10.4 Target Another Platform

This is self explanatory. The new target could be the F14, F18, or F16.

10.5 Limited Production for Evaluation Units

Produce five or six more units for installation on other aircraft or for lab demonstration.

10.6 PC-Based Data Reduction System

Develop software for reduction of DICE data on a PC platform. Possibly including incorporation of COTS data analysis software or including the software for configuring the DICE system and writing the configuration header on the data tape. It could also include a simulation to allow taking DICE to conferences or potential users for a better demonstration. TRW has already developed some limited tools on a PC for support of the DICE system.

10.7 Review Other Data Recording Options

The advances in recording technology are continuos. Advances in capability and decline in cost will improve. It is important to stay abreast of these develops in order to take advantage of a different recording option for the DICE system. This could brings improvements in data throughput rate, storage capacity, or size of the recording subsystem. The use of a standard SCSI interface in the DICE system makes for an easy switch to another recording subsystem.

10.8 Logistics Supportability Analysis

In order for DICE to become a fielded system, a logistics study will need to be initiated.

11. CONCLUSION

A prototype instrumentation system for operational tactical aircraft has been developed. The system passed an operational test in the F15 AISF. The DICE system was successfully installed in F15C, 83-0037, and passed a series of ground tests. A total of eight flight test sorties were flown at Nellis AFB during the winter of 1996. The final three sorties were flown with the Suite 2 operational flight program (OFP) which is now the fleet standard. Flight test tapes were returned to the F15 AISF at RAFB where data from one mission was analyzed to verify that good data had been recorded. This has established the final DICE proof of concept.

The requirements defined for the system in the beginning of the program have been met to various degrees. The system is compact, flight worthy, and relatively low cost. The system design provides easy access to the recording media. The system design provides some degree of reconfigurability. The design is readily adaptable to other targets. The digital tape system provides high data storage capacity in a digital format. With the exception of two interface CCAs, the system is composed of COTS equipment. The system collects and records all the data determined to be beneficial to AISF analysts responding to system problems, whether internal in origin or induced by countermeasures.

12. ACRONYMS

AISF	Avionics Integration Support Facility
ATR	Air transport racking
BIT	Built-in test
CC	Central computer
CCA	Circuit card assembly
COTS	Commercial off-the-shelf
CSCI	Computer software configuration item
CPU	Central processing unit
DICE	Data Integration and Collection Environment
ECCM	ECM/electronic counter-measurements
ECM	Electronic counter-measurements
GB	Gigabytes
HAC	Hughes Aircraft Corporation
IDRAS	Instrumentation data reduction analysis system
IIU	Instrumentation interface unit
IPS	Inches per second
IRIG	International range instrumentation group
LRU	Line replacement unit
MB	megabytes
mm	millimeter
MM	Millisecond
MPRF	Medium pulse repetition frequency
MUX	Multiplex
OFP	Operational flight plan
PACS	Programmable armament control set
PC	Personal computer
PSP	Programmable signal processor
RDP	Radar data processor
SRU	Shop replaceable unit
VME	VERSAmodule, Europe